

UNIVERSITY OF MICHIGAN
ANN ARBOR

THE HARRISON M. RANDALL LABORATORY
OF PHYSICS

Dear Francis,

Please excuse my delay in writing but somehow things involved with students got out of hand in the last few months. I'm still waiting for some photographs of papit bead models but I think that I can draw things sufficiently well so that the ideas are clear.

First pairings must take place between open regions at corresponding points on different (mannan and poppa) molecules. Then the interactions must take place which lead to the observed heterozygotes. I'll forget the first question except to say that perhaps Dr. Schwartz has a useful idea in the $\begin{matrix} A-T \\ | \\ T-A \end{matrix}$ and $\begin{matrix} G-C \\ | \\ C-G \end{matrix}$ tetrad.

At any rate the only new thing beyond the enclosed and what I said last summer is the following sequence of operations.

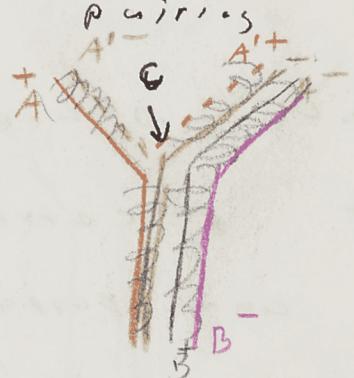
First set papit beads to do the following;

Molecule ~~A~~ A has two chains A^+ and A^- .
 drawn as $A^+ \parallel A^-$ and B has $B^- \parallel B^+$. (2)

let the ~~rotation~~ be ~~ind~~ winding of the
 chains to form the double helix
 be indicated.  I assume that the

starting time is long compared to the
 running time so that there will only
 be one start in the process. If the start
 takes place on the upper end of A

and pairing takes place ~~the~~ ~~will~~ here;

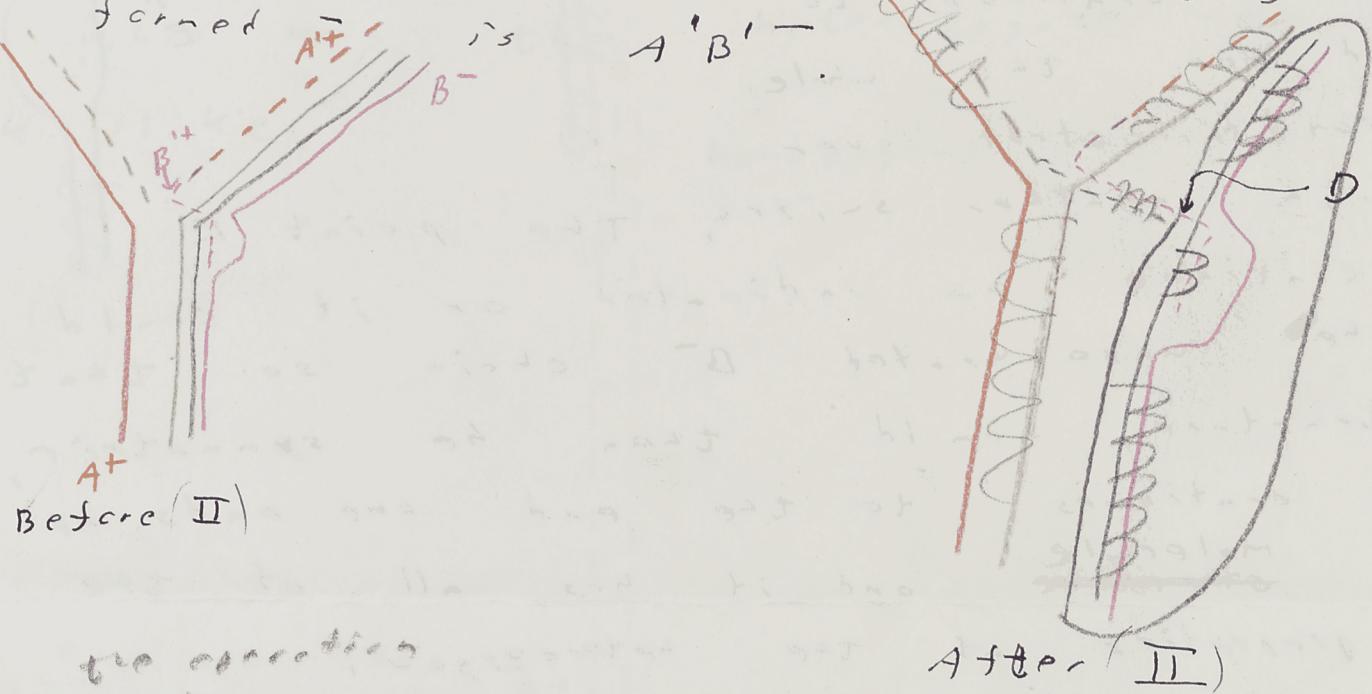


The dotted line is
 the newly formed
 daughter which will
 be labelled with a
 prime

(I) The growing point C_1^0 or A'^+
 inserts itself between the chains of B
 and continues growing on B^- at this point
 it becomes B'^+ . B'^+ need only be wrapped
 about B^- for one or two turns and
 in this region B^+ would have unsaturated
 hydrogen bonds. This process can continue
 down the chains with A'^- growing on A^+ and
 $A'^B'^+$ growing on B^- but winding around A^-
 If this were to continue to the end
 it would lead to a heterocyclic region (C)
 extending from the original switch points to
 the end of the molecule and such

(3)

structures are not found (at least to the level of 10^{-3} in phase). It also seems more likely that the grainy point of $A' -$ should switch before very long since it is constrained by the rest of the structure to be near other + ~~switches~~^{chains} to which it could switch. The closest + to which it could transfer (and also the only one which leads to short heteroaggregates) is the newly formed B'^+ . This then is taken as the second switching operation i.e., $A' -$ switches to grainy point B'^+ and thus the newly formed $A'^+ -$ is $A'^+ B'$.



After (II) the structure which is circled (i.e., B') plus the small amount of B'^+ is connected to the rest by only ~~one~~ a single phosphate-ester link at D. Therefore free rotation can take place about D.

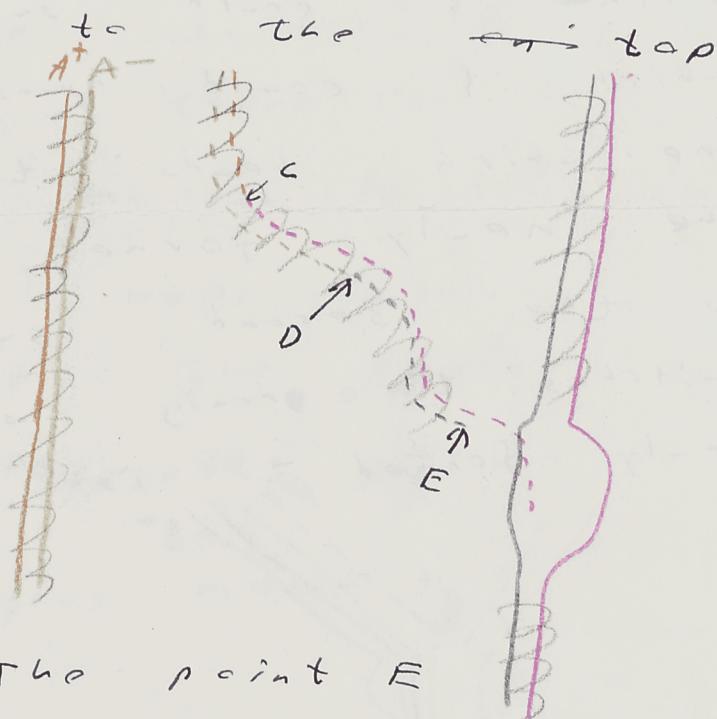
Any thermal motion which pulls B away will exert a tug on D and will cause $A'^+ B'$ and $A'^+ -$ to pull away from A. Therefore

two will then wind around each other and ④
 A^+A^- will re-inde so that there will be no net charge in the number of saturated Hydrogen bonds. No net energy is required except for the viscous drag and the gain is the free energy of separation. When this back winding sets end at A one has:

* At C the A^+ changes to B^+ and at D A^- changes to B^- . The new structure then can continue to the end or the whole this could start over again with another switch. The point E could continue as indicated or it could meet into the unsaturated B^- chain so that the structure would then be symmetric. If this continues to the end one ends up with one new molecule and it has all of the observed properties of the heterocyclo.

Both Seeman and Murray Fox have seen this with beads in fact it was Murray's sister who asked the right questions to produce the scheme. Obviously there is no reason to believe that it has anything to do with reality except that its the only one I've been able to find after a good deal of trying.

New experiments ~~to~~ to determine the factors are in progress but nothing new to report yours,



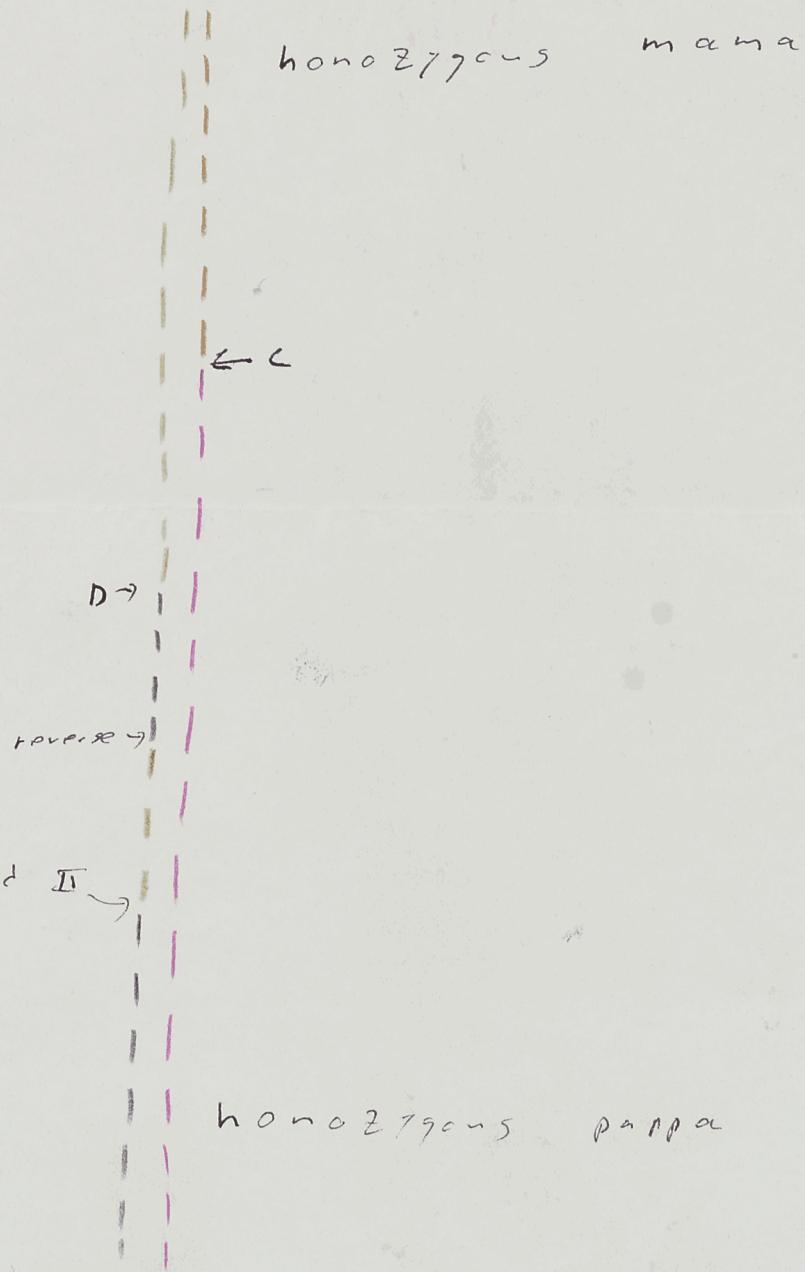
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P.S.

The apparent negative interference, that is, the high probability of switches near a switch come out of this as a rather natural way. If after the switch (II) but before the back-branching there is a reverse switch of B^{\pm} , back to A⁺ then one must start over with a type II switch before the separation. In this way the heterozygote ~~go~~ could look like



The left hand chain, that is the ~~second~~ (6)
one which switched second, has three switches. The possibility of further switches
is ended as soon as the back-winding
starts so the switches are all clustered
in the region between the first switch
at C and the B start and the
back-winding.

The testable predictions at this model are 1) that the length of the region containing multiple switches i.e., length of the negative interference region should be the same as the observed region at the heterozygote. 2) ~~The~~ All clusters of switches should contain an odd number of switches.

1) has recently been demonstrated by Doermann's lab but 2) has not yet been tested.

Yours

CY

Please let me know what you think of this.